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Driving factors of pro-environmental behavior among rural tourism destination residents-considering the moderating effect of environmental policies²

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Residents of rural tourism destinations are the core participants in organizing and carrying out rural tourism activities. Therefore, guiding them to implement pro-environmental behaviors (PEB) in the daily lives is crucial for promoting the rural ecological civilization construction and achieving sustainable rural tourism. Combining the Theory of Planned Behavior (TPB) and Normative Activation Model (NAM), this study develops a theoretical model of the driving factors of PEB among rural tourism destination residents by considering the moderating effect of environmental policies. Empirical analysis is conducted using survey data from rural tourism destination residents in Sichuan Province, China, to explain the occurrence path of PEBs from the aspects of egoistic and altruistic attributes, and environmental policy factors. The research results indicate that perceived behavioral control and environmental attitudes directly affect the pro-environmental intention (PEI) of rural tourism destination residents, and indirectly affect their PEBs, while subjective norms have no significant impact on the PEI. The personal norms of rural tourism destination residents are activated through the pathways of “consequence awareness → personal norms” and “consequence awareness → responsibility attribution → personal norms”, which in turn affect their PEIs, confirming the altruistic attributes of local residents. In addition, environmental policies have significant positive moderating effect on the conversion of PEI into PEB, but the intervention effects vary across different dimensions.

Keywords Rural tourism destination residents, Pro-environmental behavior (PEB), Theory of planned behavior (TPB), Normative activation model (NAM), Environmental policy

As the promotion of rural revitalization and high-quality development strategies, China has picked an upsurge of rural tourism development¹. According to the Ministry of Agriculture and Rural Affairs of China, by 2025, the annual tourist reception of rural leisure tourism will exceed 4 billion visitors. It has been recognized that rural tourism is an essential tool for developing rural destinations². Rural tourism, as an important component of the tourism industry, not only promotes the development of industries such as rural accommodation and catering, but also improves the income level of rural residents³. In addition, it has strong industrial integration and local economic driving functions, fully in line with the core domestic demand of rural revitalization strategy, and is a key path for high-quality rural development. However, the rapid development of the tourism industry has also caused serious damage to the local environment⁴, such as tourists littering^{5,6}, residents illegally construction, arbitrary discharge of domestic sewage^{7,8}, and improper disposal of domestic waste⁹. Environmental damage will reduce tourist satisfaction and revisit rates, thereby affecting tourism revenue and long-term constraining the prosperity of rural tourism industry. At present, extensive research has been conducted on the PEB of tourists and residents based on TPB and NAM theories, which provide strong theoretical support for understanding the behavioral decisions of individuals and groups in environmental protection¹⁰. However, existing research has mostly focused on tourists, with less attention paid to the PEB of tourist destination residents and other stakeholders. In the development process of rural tourism in China, residents are one of the important stakeholders⁸ who have a symbiotic relationship with the ecological environment¹¹. Guiding and promoting

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residents' environmental awareness and behavior is the key to maintaining the rural ecological environment and achieving beautiful rural construction. In addition, from a spatial perspective, tourist destinations involve different geographical scales¹², such as rural areas, cities, and countries. Most studies focus on representative cultural tourism destinations such as national parks^{13–15} and cultural cities^{16–18}, with relatively little attention paid to the behavior of residents in rural tourism destinations. However, such research is of great significance for community level environmental protection and sustainable development of rural tourism destinations. In the context of China's rural revitalization and high-quality rural development strategy, exploring the driving forces of environmental behavior among rural tourism destination residents is worth paying attention to.

Pro-environmental behavior (PEB) refers to the proactive actions taken by individuals or groups to reduce negative impacts on the destination environment and resources⁵. In early research, the impact of demographic factors such as age, gender, education level, and family size on PEB was explored^{5,19–21}. As Chen et al. pointed out in their study on PEB among urban residents in China, women²², youth²³, higher education²³, and environmental attitudes increase the likelihood of participating in environmental behaviors¹⁹. However, due to the lack of empirical data, these studies have not been extended to rural tourism destinations, making it difficult to fully validate the research result. Due to differences in economic conditions, social networks, and policy orientations, there are significant differences in the driving factors of PEB between urban and rural residents in China²⁴. In rural areas, the development of rural tourism has had a huge impact on the local economy, cultural development, and social relations^{2,25} and the PEB of local residents will have an important impact on the sustainable development of local tourism. Therefore, in the context of vigorously developing rural tourism in rural areas of China, it is necessary to conduct in-depth research on PEB targeting rural residents.

Subsequently, ongoing research on PEB found that demographic factors cannot fully explain residents' PEB, and individual behavior is also driven by psychological factors²⁶. For example, Takahashi and Sefla conducted a study on the PEB of rural residents based on psychological factors²¹. The results indicated that environmental attitudes and local attachment are the most significant factors influencing PEB, confirming the driving role of psychological factors in behavior occurrence²¹. Through in-depth research, some researchers have conducted predictive analysis of PEBs such as residents and tourists based on classic theories of psychological behavior²⁷. Bagheri et al. studied the behavior of farmers in the safe use of pesticides by applying the theory of planned behavior(TPB), and found that attitudes, perceived behavioral control, and subjective norms jointly explain the occurrence of farmers' intention to use pesticides safely, confirming the effectiveness of TPB theory in explaining residents behavior²⁸. However, TPB overly focuses on individual cognitive factors such as behavioral attitudes, subjective norms, and perceived control, believing that the occurrence of resident behavior is the result of a rational balance between expected benefits and costs, with egoistic attributes, and ignoring the social context in which behavior is formed²⁹. Compared with the egoism perspective, the norm activation model (NAM) theory introduces responsibility attribution variables with obvious social and altruistic attributes to compensate for the one sidedness of egoistic attributes, believing that residents' behavior is driven by moral considerations^{16,30}. Wang et al. selected Chinese urban residents as the research subjects and studied the factors that affect residents' habitual energy-saving behavior based on TPB and NAM models³¹. The results showed that urban residents' daily energy-saving behavior is mainly driven by altruistic considerations, combination of two theoretical models has improved the predictive ability of residents' behavior to a certain extent³¹. At present, it remains to be verified whether there is also altruistic psychology in the PEB of residents in rural tourism destinations.

Furthermore, relying solely on psychological factors is insufficient to fully explain the driving mechanism of PEB in rural tourism destinations²⁶. In the context of sustainable tourism development, research on the PEB of rural tourism destination residents also needs to comprehensively consider the impact of environmental policy factors. The occurrence of individual behavior is not entirely spontaneous, often the result of individual willingness interaction under environmental policies intervention³¹. Especially for residents in rural areas, the impact of environmental policies is more significant³¹. The Chinese government has implemented a regulatory policy system that combines incentives and punishments for green behavior³². Studies have found that regulatory agencies' economic subsidy policies effectively increase consumers' consumption of green products³³. Shi et al. used a comprehensive research model based on TPB and attitude-behavior-condition theory to predict the impact of psychological and policy factors on residents' PM2.5 emission reduction behavior²⁶. They found that policy measures have a significant moderating effect on the transition from intention to actual behavior, and policy factors play a key role in narrowing the gap between individual intention and actual behavior²⁶. In terms of urban residents' garbage classification policies, it has been found that government policy incentives have a positive moderating effect on residents' intention-behavior relationship in waste classification, which can promote intention behavior conversion³⁴. In addition, Ajzen also pointed out that when there is a significant difference between intention and behavior, other variables can be added to enhance the explanatory power of the model³⁵. However, previous research has focused on explaining residents' behavior through a single dimension of environmental policies, making it difficult to evaluate the mechanisms and effects of different types of environmental policies^{36,37}. Environmental policies have a certain effect on regulating the gap between willingness and behavior, while the effects of economic policies and mandatory policies are different³⁴. There are three main types of environmental policies for rural tourism destinations: command and control, economic incentive, and public participation policies. It is worth exploring how different government regulatory policies affect the driving force of PEB among residents in rural tourism destinations.

Therefore, based on existing research, this study integrates TPB and NAM theories, explores the driving factors of PEB among residents in rural tourism destinations from the perspectives of egoism and altruism, combining with environmental policy factors. This exploration fills the gap in previous research that was limited to individual level influencing factors, considers the impact mechanism of external environmental factors on PEB of rural tourism destination residents, and provides a new perspective for exploring the driving factors of PEB. At the same time, using multi-group analysis to explore whether there are differences in PEB driving

pathways among different gender, education level, and income groups has improved the analysis of the impact of individual demographic factors on behavior. Finally, based on the analysis results, corresponding suggestions are provided to encourage residents of rural tourism destinations to actively implement PEBs and achieve sustainable development of rural tourism destinations.

Theoretical basis and hypotheses

TPB and related hypotheses

TPB originates from the Theory of Rational Action (TRA), which suggests that pro-environmental intention (PEI) is determined by factors of perceived behavioral control (PBC), subjective norm (SN), and environmental attitude (EA)³⁸. Among them, PBC refers to the difficulty of an individual implementing a certain behavior, that is, the subjective cognition of factors that promote or hinder their behaviors^{34,39,40}, which largely depends on the balance of costs and benefits for the individual. SN refers to the pressure that individuals feel when executing a certain behavior or not, mainly from individuals or groups who have influence on their behavioral decisions^{28,34,41}. EA refers to an individual's perception and evaluation of the benefits or disadvantages of performing a specific behavior^{5,34,40}. According to the TPB, when residents of rural tourism areas perceive that a good ecological environment can not only reduce environmental pollution, but also generate ecological benefits and bring them economic benefits, they will have a strong willingness to implement it. Previous studies have validated the feasibility of TPB in studying the behaviors of residents, tourists, and students. For example, Zhang et al.³⁴ investigated key factors affecting the intention and behavior of residents to classify household waste. Lee⁴² found in the study on environmental intentions among Hong Kong youth that both perceptual behavior control and subjective norms affect environmental intention directly, with subjective norms influencing environmental intention through perceptual behavior control. Arli et al.⁴⁰ also confirmed this viewpoint in their research on green product purchase intention. Gao et al.³⁹ applied an extended model of TPB theory to explore energy-saving behavior in the workplace, indicating that subjective norms and perceived behavioral control positively affect employees' energy-saving awareness. Therefore, in order to explore the path for rural tourism destination residents to form PEB under egoistic attributes, this study proposes the following hypotheses:

H1: Perceived behavioral control positively affects the pro-environmental intention of rural tourism destination residents.

H2: Subjective norms positively affect the pro-environmental intention of rural tourism destination residents.

H3: Environmental attitude positively affects the pro-environmental intention of rural tourism destination residents.

H4: Pro-environmental intention positively affects the pro-environmental behavior of rural tourism destination residents.

NAM theory and related hypotheses

Schwartz proposed the NAM in 1977, which is a widely used social psychological theory that primarily applied to predict and explain individual altruistic behavior. Personal norms (PN), awareness of consequences (AC), and attribution of responsibility (AR) constitute the core variables of the NAM^{30,43}. AC refers to the awareness of residents towards the negative consequences of not implementing PEB, while AR refers to the individual's sense of responsibility for not taking certain actions and resulting in adverse consequences^{30,44,45}. Before taking action, when residents realize that not taking action will have adverse consequences and feel responsible, they are more willing to participate in PEB. PN refers to the self-expectations of individuals in implementing specific behaviors in a particular situation^{30,46}, which are internalized social norms and a sense of moral obligation towards oneself⁴⁴. According to the NAM theory, when individuals realize that their behaviors may have a negative impact on the environment, they tend to take responsibility for the negative consequences of their actions. This also indicates that an individual's awareness of consequences is an important prerequisite for AR. In addition, if an individual realizes the positive consequences of PEB and feels responsible for protecting the ecological environment, their PN will be higher and their willingness to implement PEB will be stronger. For instance, Zhu et al.⁴⁴ integrated the NAM-TPB model to discuss the consumption intention of game meats. The results showed that AR plays a mediating role within the NAM, intervening in the connection between AC and PN. Therefore, to explore the occurrence path of the willingness of rural tourism destination residents to engage in PEB under the altruistic attributes, this study proposes the following four hypotheses:

H5: Consequence awareness positively affects the attribution of responsibility of rural tourism destination residents.

H6: Consequence awareness positively affects personal norms of rural tourism destination residents.

H7: Attribution of responsibility positively affects personal norms of rural tourism destination residents.

H8: Personal norms positively affect pro-environmental behavior willingness of rural tourism destination residents.

The moderating effect of environmental policies on rural tourism destination residents

The PEB of residents in rural tourism destinations is not only influenced by psychological factors, but also regulated by environmental policies⁴⁷. Gadenne et al.⁴⁸ found that governmental policies may affect the relationship between attitudes and behaviors, rather than influence the behaviors directly. As a normative group in tourist destinations, environmental policies have a more profound effect on the residents of tourist destinations than other stakeholders³⁶. In current research on the moderation effect of environmental policies, the moderating effect on individual environmental behavior decisions in tourist destinations is mainly studied from a single dimension. For example, Zhang et al.³⁴ examined the key influencing factors of waste separation intention and behaviors of residents based on TPB and attitude-behavior-condition theories, and the moderating effect of incentive policies on the intention-behavior relationship is explored with a single dimension of

environmental policy factor. Wang et al.¹⁷ explored the antecedents of households' willingness to collect solid waste separately by extending the TPB, which showed that the willingness was significantly influenced by age, outcome perception, and government policies. According to existing studies^{26,47,49} and field investigations, environmental policies for rural tourism destinations are categorized into three types: command and control policies (CCP), economic incentives policies (EIP), and public participation policies (PPP). Therefore, this study involves these three environmental policies as moderating variables into the TPB-NAM integrated theoretical framework, to explore the moderating effects of different dimensions of environmental policies between PEIs and PEBs of rural tourist destination residents. In order to clarify the different effects of various dimensions of policies in promoting the transformation of intention to actual behaviors in tourist destinations, and further propose corresponding recommendations. Therefore, this study proposes the following hypotheses:

H9: Command and control policies have a positive moderating effect on the willingness to engage in pro-environmental behavior and behavior among rural tourism destination residents.

H10: Economic incentive policies have a positive moderating effect on the willingness to engage in pro-environmental behavior and behavior among rural tourism destination residents.

H11: Public participatory policies have a positive moderating effect on the willingness to engage in pro-environmental behavior and behavior among rural tourism destination residents.

Theoretical model establishment

Based on the above analysis, this study is based on TPB and NAM theories, introducing three dimensions of environmental policies as moderating variables and proposing relevant research hypotheses. An improved model is established to explore the influencing factors and driving mechanisms of PEBs among residents in rural tourism destinations. The conceptual model is shown in Fig. 1.

Research methods

Design of measurements

Based on the theoretical model and the proposed 11 research hypotheses, the questionnaire on influencing factors of rural tourism residents' PEB is designed for in-depth research. All constructs in the current research are latent variables with a measurement of multi-item scales, which are developed based on prior studies with some amendments to meet the context of this research. The questionnaire includes two parts. The first part

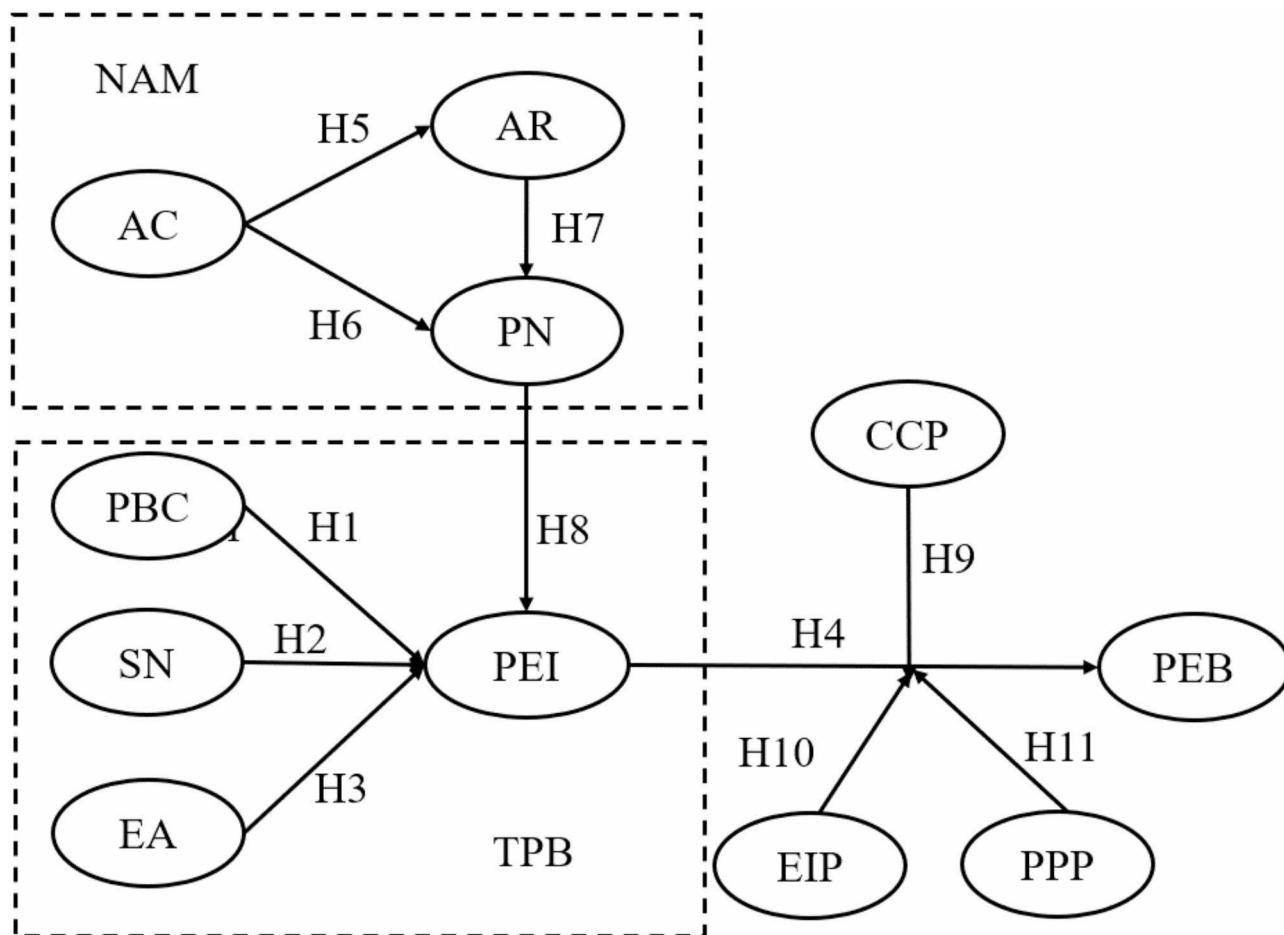


Fig. 1. Conceptual model of this study.

is the background information of the respondents, including age, gender, education level, income, and other demographic variables. The second part is about the factors that affect the implementation of PEB by residents in rural tourism destinations, including key components of TPB and NAM theories, as well as the three dimensions of environmental policies. A total of 11 variables and 33 scale items were designed, as shown in Table 1. These questions are measured using the Likert 5-level scale, in which “1” indicates strongly disagree, “2” indicates relatively disagree, “3” indicates average, “4” indicates relatively agree, and “5” indicates strongly agree. Specifically, there are three AC items rated based on the residents’ perception of the consequences of local environmental damage in rural tourist destinations^{30,44,45}; Three AR items rated according to the perception and identification of residents in rural tourist destinations regarding their responsibility to protect the local environment^{30,44,45}; Three PN items rated according to local residents’ self-expectations for implementing PEBs^{30,44,45}; Three PBC items rated based on residents’ perceived difficulty in implementing PEBs^{28,34,39,41}; Three SN items scored according to the pressure residents feel when implementing or not implementing PEBs^{28,34,39,41}; Three EA items rated based on the local residents’ positive or negative perceptions of implementing PEBs^{28,34,39,41}; Three PEI items scored based on the degree of inclination of local residents towards environmental protection behavior PEBs^{28,34,39,41}; Three PEB items rated based on the behavioral manifestations of rural tourist destinations residents^{28,34,39,41}; and three CCP, EIP, and PPP items respectively scored according to the implementation of PEBs by residents under the requirements of mandatory, incentive, and guiding policies in the rural tourism destinations^{26,47,49}.

The draft questionnaire was reviewed and revised by experts from the Xingwen County Environmental Protection Bureau in China, including two experts in the field of environmental behavior and two in the field of rural tourism destination environmental protection. They have extensive experience in combining cognitive theory with residents’ environmental behavior, which further ensures the clarity and completeness of the questionnaire content. Prior to the formal survey, a presurvey was conducted on the residents near the rural tourism scenic area of Bo Wang Shan Town, Sichuan Province. During the pre-survey stage, a total of 80 questionnaires were collected, and it was found that the main issue was the respondents’ lack of accurate understanding of the questionnaire content. After modifying the items, the final version corresponding to the 33 items was certified for data collection, as shown in Table 1.

Data analysis method

Structural equation modeling (SEM) is applied to analyze the questionnaire data. As a method for developing, estimating, and testing causal models, SEM not only contains observable explicit variables, but also latent variables that cannot be directly observed, and can comprehensively analyze the role of individual indicators and the interrelationships between them^{50–52}. In SEM, variables are treated as random variables, and their relationships are determined by an equation model. equation models are typically represented by causal diagrams, which

Variable	Definition
Awareness of consequence (AC) ^{30,44,45}	“Environmental degradation will be a problem for my family and future generations” “Environmental pollution is becoming increasingly severe, which will seriously affect our own health” “If the environment is not protected, it will damage the development of this tourist destination”
Attribution of responsibility (AR) ^{30,44,45}	“I am responsible for any behavior that damages the environment of this tourist destination” “I am responsible for hindering the sustainable development of this tourist destination” “Everyone has an obligation to take action for the environmental protection of this tourist destination”
Personal norms (PN) ^{30,44,45}	“Individuals have an obligation to protect the environment and conserve resources” “Wasting natural resources makes me feel guilty” “Protecting the environment and energy will make me a better person”
Environmental attitudes (EA) ^{28,34,39,41}	“I believe that protecting the environment of this tourist destination is beneficial for the development of rural tourism industry” “I think it’s worth spending time and money to protect the environment of this tourist destination” “When I see someone damaging the environment of this tourist destination, I get very angry”
Subjective norms (SN) ^{28,34,39,41}	“My family and friends believe that I should take action to protect the environment of this tourist destination” “My family and friends hope that I should take action to protect the environment of this tourist destination” “If I take action to protect the environment of this tourist destination, my family and friends will be very happy”
Perceived behavioral control (PBC) ^{28,34,39,41}	“As long as I am willing, I can take actions to protect the environment of this tourist destination” “I believe that taking action to protect the environment of this tourist destination is entirely up to me” “I have the time and energy to improve the environment of this tourist destination”
Pro-environmental intentions (PEI) ^{28,34,39,41}	“I am willing to actively participate in the environmental protection of this tourist destination” “I am willing to discuss topics related to the ecological environment of scenic spots” “I am willing to join the environmental volunteer team of this tourist destination”
Pro-environmental behavior (PEB) ^{28,34,39,41}	“I will try to persuade my family and friends to take actions that are beneficial to the environment of this tourist destination” “When I see others damaging the environment here, I will report it to the relevant authorities” “When I see garbage and fruit peels in the scenic area, I will pick them up”
Command-and-control policy (CCP) ^{26,47,49}	“The mandatory regulations on environmental protection issued by the government will encourage me to protect the environment” “The government’s policy of mandatory waste classification and recycling will encourage me to implement environmental protection actions” “The government’s restrictions on purchasing inefficient household appliances encourage me to choose energy-efficient appliances when making purchases”
Economic incentive policy (EIP) ^{26,47,49}	“I am more willing to participate in activities that offer government subsidies to protect the environment” “The government collects pollution fees, and I will be more actively involved in environmental protection actions than before” “In order to avoid fines from some departments, I have to participate in some environmental protection activities”
Public participation policy (PPP) ^{26,47,49}	“The disclosure of the air pollution index of this tourist destination will motivate me to participate in environmental protection activities” “When a tourist destination obtains rural tourism certification, it will motivate me to participate in environmental protection” “I tend to purchase products with environmental labels in my daily life”

Table 1. Definitions of each construct.

include measurement models that describe how each variable is measured and structural models that describe the relationships between variables⁵⁰. Through the fitting and parameter estimation, the strength and direction of the relationship between each variable and the action mechanism can be explored, which helps to understand the complex relationship between the variables and better grasp the nature of the research object⁵¹. Therefore, this study applies AMOS26.0 software and SPSS26.0 to test the reliability and validity of the data collected from the questionnaire. Path test and moderating effect analysis are conducted in conjunction with related research hypotheses, to explore in depth the driving factors of PEBs among residents in rural tourism destinations.

Empirical study

Background information and data collection

Xingwen County is one of the areas with the richest tourism resources in Sichuan province, with 4 national 4 A level tourist attractions, 4 national 3 A level tourist attractions, 1 tourist resort, and nearly 100 representative scenic spots. In 2021, it was listed as a county with significant achievements in rural revitalization, and was selected as the fifth batch of Tianfu Tourism Famous Counties in 2023, occupying an important position in rural tourism destinations in Sichuan Province. There are 8 towns and 4 townships in this county, among which Shuiluba Community, Bowang Village, Yongshou Village, and Shihai Village have been rated as provincial key villages for rural tourism. Therefore, this study selects residents from 12 representative villages and communities in Xingwen County as survey respondents, and conducted empirical research through on-site questionnaire distribution to collect data in a timely and effective manner, ensuring the scientific quality of the data. A total of 340 questionnaires were distributed, in which 316 valid questionnaires were retained after excluding incomplete and randomly filled invalid questionnaires, with an effective rate of 92.9%.

Data analysis results

Sample description

The demographic characteristics of the collected samples are shown in Table 2. 42.4% of the respondents were male and 57.6% were female. Their monthly income was mainly under 6000 yuan, which was consistent with the trend of Xingwen County's income level. Their educational level was mainly below senior high school or technical, accounting for 76.9%. Their occupation as farmers and self-employment are 37% and 21.2%, respectively.

Demographic variables	Category	Frequency	Percentage
Gender	Male	134	42.4
	Female	182	57.6
Age	Under 18	4	1.3
	18 ~ 35	70	22.2
	36 ~ 45	51	16.1
	46 ~ 55	115	36.4
	55 or above	76	24.1
Monthly income (RMB)	Under 3000	143	45.3
	3000 ~ 6000	134	42.4
	6001 ~ 9000	25	7.9
	9001 and above	14	4.4
Education level	Lower secondary or below	132	41.8
	Senior high school or Technical	111	35.1
	Junior college	57	18.0
	University degree and above	16	5.1
Residence duration(year)	1 ~ 5	18	5.7
	6 ~ 10	20	6.3
	11 ~ 15	25	7.9
	16 ~ 20	37	11.7
	21 and above	216	68.4
Occupation	Farmer	117	37
	Self-employment	67	21.2
	Corporate staff	49	15.5
	Student	21	6.6
	Government staff	14	4.4
	Retirement	9	2.8
	Other personnel	39	12.3

Table 2. Demographic characteristics of the respondents.

Test for scale reliability and validity

SPSS26.0 and AMOS26.0 software are used to analyze the reliability and validity of the survey data, and the reliability of the scale is tested by counting Cronbach's alpha coefficient and combined reliability (CR) comprehensively. The test results are shown in Table 3. The Cronbach's α values of the latent variables range between 0.767 and 0.858, and the CR values range between 0.768 and 0.859. Both of them are greater than 0.7, indicating that the reliability of the scales is high^{52,53}.

In addition, factor loading and average variance extracted (AVE) are used to evaluate the convergence validity. From the results shown in Table 3, the factor loadings values are range from 0.673 to 0.858, and the AVE of the latent variables ranges from 0.524 to 0.670. Factor loading greater than 0.6 and AVE greater than 0.5 indicate that the scale has good convergent validity and every latent variable is well explained by the observed variables^{28,52}.

Meanwhile, as shown in Table 4, the square root of the AVE value of each latent variable is higher than the correlation coefficient, and the discriminant validity of the questionnaire items is acceptable⁵².

Results of hypothesis testing

The fitness coefficient usually verifies the fit of the model to determine whether it fits well with the data. Commonly used fitness coefficients include chi-square/degrees of freedom (χ^2/df), comparative fit index (CFI), Tacker-Lewis's index (TLI), incremental fit index (IFI), goodness-of-fit index (GFI), root-mean-square error of approximation (RMSEA). In this study, the goodness-of-fit of the structural equation model is listed in Table 5. For the overall adaptability of the model, $\chi^2 = 685.563$, $df = 563$, $p = 0.000$, $1 < \chi^2/df = 1.218 < 3$, $RMSEA = 0.030 < 0.08$, $TLI = 0.963 > 0.9$, $CFI = 0.969 > 0.9$, and $IFI = 0.970 > 0.9$, all indicators have passed the test, indicating a high degree of fit between the theoretical model and the sample data and good reliability of the estimation results⁵⁴. Hence, all evaluation indicators satisfy the evaluation standard.

Latent variables	Observed variables	Cronbach's α	Loading	CR	AVE
AC	AC1	0.771	0.803	0.776	0.538
	AC2		0.718		
	AC3		0.673		
AR	AR1	0.805	0.760	0.808	0.584
	AR2		0.714		
	AR3		0.823		
PN	PN1	0.806	0.746	0.810	0.588
	PN2		0.785		
	PN3		0.761		
PBC	PBC1	0.821	0.745	0.825	0.612
	PBC2		0.788		
	PBC3		0.812		
SN	SN1	0.848	0.835	0.851	0.655
	SN2		0.800		
	SN3		0.792		
EA	EA1	0.767	0.738	0.768	0.524
	EA2		0.756		
	EA3		0.676		
PEI	PEI1	0.839	0.834	0.841	0.639
	PEI2		0.750		
	PEI3		0.812		
CCP	CCP1	0.854	0.857	0.856	0.666
	CCP2		0.755		
	CCP3		0.832		
EIP	EIP1	0.851	0.858	0.853	0.660
	EIP2		0.742		
	EIP3		0.833		
PPP	PPP1	0.808	0.739	0.8102	0.588
	PPP2		0.751		
	PPP3		0.808		
PEB	PEB1	0.858	0.809	0.8587	0.670
	PEB2		0.796		
	PEB3		0.849		

Table 3. Results of confirmatory factor analysis. Cronbach's A Cronbach's alpha, CR critical ratio, AVE average variance extracted.

	AC	AR	PN	PBC	SN	EA	PEI	CCP	EIP	PPP	PEB
AC	0.726										
AR	0.551	0.764									
PN	0.329	0.37	0.767								
PBC	0.320	0.224	0.233	0.782							
SN	0.195	0.16	0.24	0.365	0.809						
EA	0.155	0.254	0.194	0.437	0.455	0.724					
PEI	0.141	0.176	0.26	0.446	0.374	0.540	0.799				
CCP	0.138	0.161	0.213	0.115	0.164	0.207	0.395	0.816			
EIP	0.229	0.227	0.241	0.411	0.047	0.271	0.348	0.170	0.813		
PPP	0.232	0.275	0.424	0.321	0.225	0.295	0.338	0.413	0.437	0.767	
PEB	0.233	0.160	0.300	0.309	0.358	0.416	0.422	0.352	0.425	0.436	0.818

Table 4. Results of discriminative validity analysis. Crosswise elements are the square root of the variance extracted. Off-diagonal elements are the correlations among constructs.

Evaluation index	χ^2/df	RMSEA	TLI	CFI	IFI	GFI
Evaluation standard	$1 < \chi^2/df < 3$	<0.08	>0.9	>0.9	>0.9	>0.9
Model fit	1.792	0.030	0.932	0.942	0.942	0.901

Table 5. Model goodness-of-fit results of the structural equation model.

Hypothesis	Estimate	S.E.	C.R.	Supported
H1: PBC→PEI	0.221**	0.085	7.062	Yes
H2: SN→PEI	0.109	0.097	2.231	NO
H3: EA→PEI	0.393***	0.090	2.970	Yes
H4: PEI→PEB	0.453***	0.069	3.147	Yes
H5: AC→AR	0.558***	0.070	1.587	Yes
H6: AC→PN	0.197*	0.118	4.797	Yes
H7: AR→PN	0.260**	0.067	6.777	Yes
H8: PN→PEI	0.131*	0.070	2.227	Yes

Table 6. SEM path test coefficients. *** indicates $p < 0.001$, ** indicates $p < 0.01$, * indicates $p < 0.05$.

To analyze the variable relationship and path coefficients in the model, AMOS26.0 is adopted to build the SEM. The inspection results based on SEM, including the standardized path coefficients, significance, and explanatory power of endogenous latent, are shown in Table 6. In the TPB framework, PBC→PEI ($\beta = 0.221$, $P < 0.05$), EA→PEI ($\beta = 0.393$, $P < 0.001$), PEI→PEB ($\beta = 0.453$, $P < 0.001$) are statistically significant, SN→PEI ($\beta = 0.109$, $P = 0.113$) is not significant, showing that H1, H3 and H4 are supported, H2 is not supported. In the NAM framework, AC→AR ($\beta = 0.558$, $P < 0.001$), AC→PN ($\beta = 0.197$, $P < 0.05$), AR→PN ($\beta = 0.260$, $P < 0.05$) and PN→PEI ($\beta = 0.131$, $P < 0.05$) are statistically significant, thereby demonstrating that H5, H6, H7 and H8 are supported. As shown in Fig. 2, the willingness to engage in PEB can be activated through four pathways, namely “PBC→PEI”, “EA→PEI”, “AC→PN→PEI” and “AC→AR→PN→PEI”. Personal norms can be directly activated through consciousnesses of results, or indirectly activated through attribution of responsibility. The formation mechanism of residents’ environmental behavioral intentions in rural tourism destinations is preliminarily obtained, which is based on the awareness of consequence as the fundamental trigger point, environmental intentions as the key node, connecting other influencing factors such as, perceived behavior control, behavioral attitudes and personal norms. Based on multiple chain interactions, a hierarchical and orderly structural network is formed.

Moderating effects of external factors

SPSS26.0 software is used to decentralize the data of four variables: command and control environmental policy, economic incentive environmental policy, public participation environmental policy, and environmental intention. Then the hierarchical regression method is used to analyze the moderating effect of the variables. At the first level, the PEB is taken as the dependent variable, and the independent variable environmental intention is added; at the second level, the contextual variables, environmental policies of each dimension are added; at the third level, the variables resulting from the interaction between the contextual variables and the independent variables are added (PEI × CCP, PEI × EIP, PEI × PPP). If the significance level of the variables PEI×CCP,

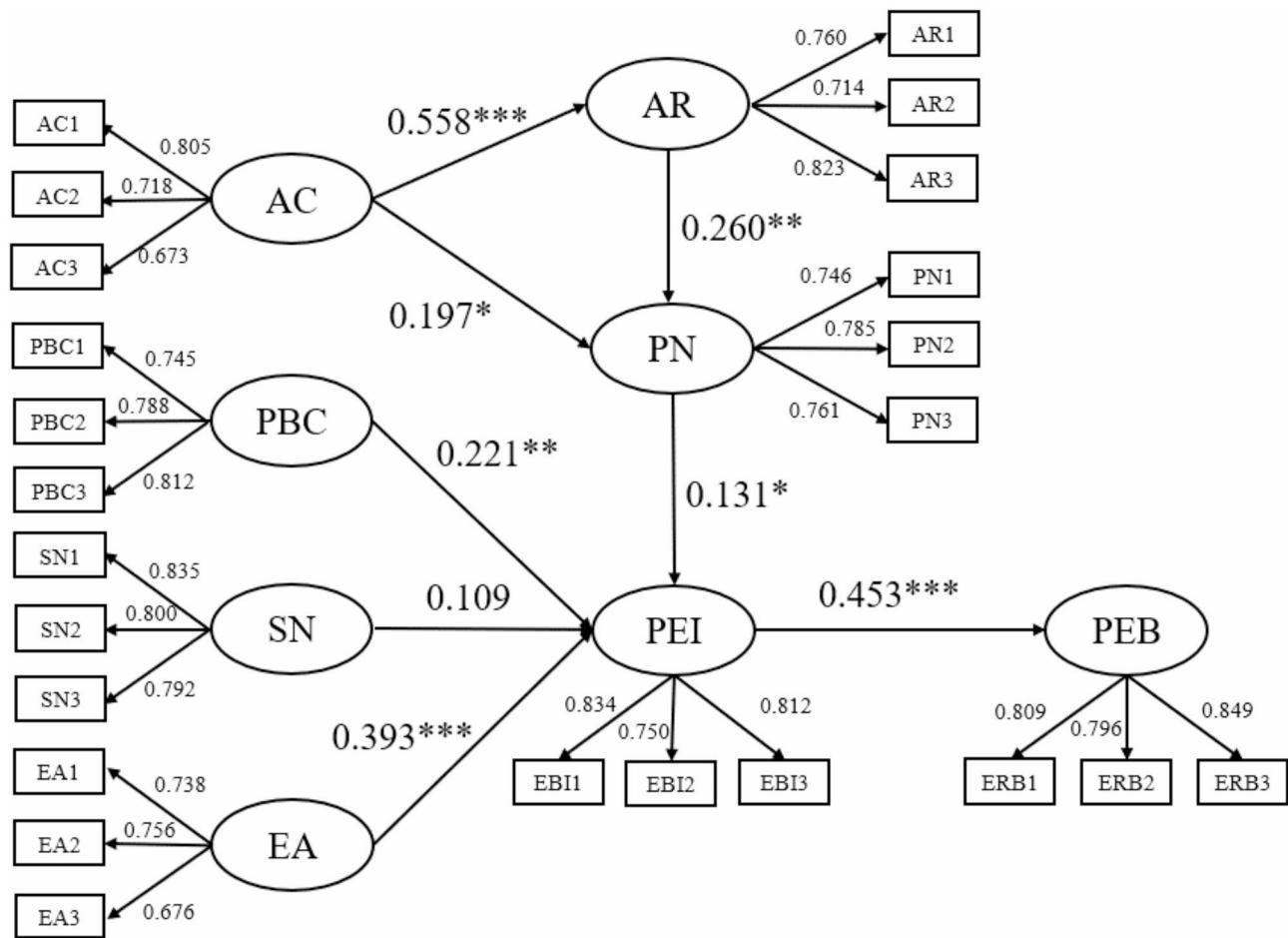


Fig. 2. Structural equation model and standardized path coefficients. *** indicates $p < 0.001$, ** indicates $p < 0.01$, * indicates $p < 0.05$.

Project	Variable	Dependent variable: pro-environmental behavior							
		Model 1		Model 2		Model 1		Model 2	
Independent variable	PEI	0.301***	0.354***	PEI	0.280***	0.264***	PEI	0.289***	0.300***
Moderator variable	CCP	0.199***	0.205***	EIP	0.291***	0.252***	PPP	0.321***	0.300***
Multiplicative variable	PEI×CCP		0.190***	PEI×EIP		0.187**	PEI×PPP		0.104**
Model summary	F	29.491***	24.808***	F	38.504***	29.100***	F	38.361***	27.286***
	R ²	0.159***	0.193***	R ²	0.197***	0.211**	R ²	0.197***	0.208**
	ΔF	29.491***	13.151***	ΔF	38.504***	8.457**	ΔF	38.361***	4.321**
	ΔR ²	0.159***	0.034***	ΔR ²	0.197***	0.021**	ΔR ²	0.197***	0.11**

Table 7. Results of moderating effect analysis. *** indicates $p < 0.001$, ** indicates $p < 0.01$.

PEI×EIP and PEI×PP generated by the interaction is below 0.05, it indicates that the contextual variables have a moderating effect. The results of the validation are shown in Table 7 where the variable PEI × CCP ($\beta = 0.190$, $P < 0.001$), PEI × EIP ($\beta = 0.187$, $P < 0.05$) and PEI × PPP are significant ($\beta = 0.104$, $P < 0.05$), so that the hypotheses H19, H10, and H11 are supported.

This study discusses the moderating effect of three types of environmental policy factors on the intention-behavior of residents in rural tourism destinations. The results in Table 7 indicate that command-and-control policies, economic incentive policies, and public participation policies have significant moderating effects on the intention-behavior relationship of residents' PEB in rural tourism destinations. To further illustrate the moderating effect of the three types of policies, the simple slope test proposed by Aiken and West was used⁵⁵. Firstly, the data for CCP, EIP, PPP, PEI and PEB are standardized. Then, the CCP, EIP, and PPP values with one standard deviation above and below the average are used to plot their regulatory effects. The interaction diagram

is shown in Fig. 3. When the intensity of the three types of environmental policies is enhanced, it will further promote the implementation of PEB by residents.

Multi-group analysis

Based on the integrated TPB-NAM framework, AMOS26.0 is used to select three variables: gender, income level, and education level to analyze inter group heterogeneity. From the perspective of the invariance test model, the comparison between the preset model and the multi-group model. The χ^2/df distribution ranges from 1.503 to 1.588, CFI distribution ranges from 0.910 to 0.925, IFI distribution ranges from 0.911 to 0.927, TLI distribution ranges from 0.903 to 0.916, and RMSEA distribution ranges from 0.040 to 0.043. Therefore, the multi-group structure model is well adapted to the sample data, and path difference analysis can be performed by grouping gender, education level, and income based on the original model settings⁵⁶.

As shown in Table 8, in the path “AC→AR”, the total effect of the male population is 0.028 higher than that of the female population; the group with an income above 3000 yuan is 0.183 higher than the group that below 3000 yuan; and the group with an education level of high school and above is 0.065 higher than that of the group with a middle school and below. In the path “EA→PEI”, the total effect of the male population is 0.182 higher than that of the female population; the group with income below 3000 yuan is 0.229 higher than that of above 3000 yuan; the group with education level of high school and above is 0.231 higher than that of middle school and below. In the path “PEI→PEB”, the total effect of the female population is 0.158 higher than that of the male population; the group with income below 3000 yuan is 0.340 higher than that of above 3000 yuan; the group with education level of high school and above is 0.091 lower than that of the group with education level of junior high school and below. In the path “AR→PN”, only the groups with different income showed significant differences, and the total effect of the group with income below 3000 yuan was 0.229 higher than that of the group with income above 3000 yuan.

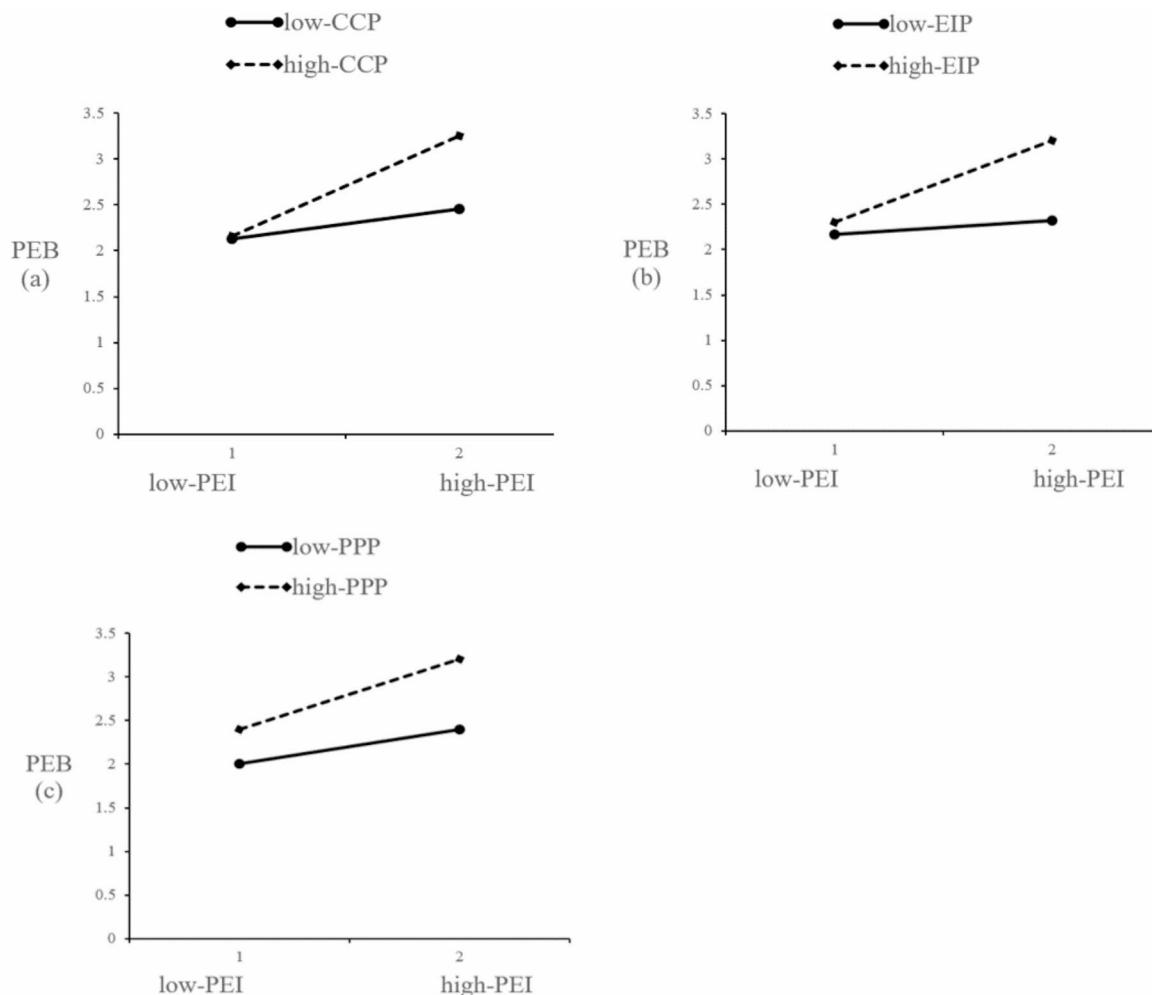


Fig. 3. Simple slope plots of the regulatory effects of CCP(a), EIP(b), and PPP(c).

Hypothesis	Gender group		Monthly income group		Education level group	
	Male	Female	Below 3000 yuan	3000 yuan and above	Junior high school and below	Senior high school and above
H1: AC \rightarrow AR	0.567 ***	0.539***	0.441***	0.624***	0.527***	0.592***
H2: AC \rightarrow PN	0.172	0.226	0.225*	0.176	0.364**	0.082
H3: AR \rightarrow PN	0.447 ***	0.145	0.198*	0.369**	0.057	0.415***
H4: PBC \rightarrow PEI	0.183	0.244**	0.437***	0.011	0.158	0.236**
H5: SN \rightarrow PEI	0.107	0.112	0.02	0.278**	0.47***	-0.029
H6: EA \rightarrow PEI	0.302**	0.484***	0.483***	0.254**	0.215*	0.446***
H7: PEI \rightarrow PEB	0.379***	0.537***	0.616***	0.276***	0.524***	0.433***
H8: PN \rightarrow PEI	0.214**	0.073	0.276***	-0.044	0.132	0.117

Table 8. Standardized path analysis of group differences. *** indicates $p < 0.001$, ** indicates $p < 0.01$, * indicates $p < 0.055$.

Discussions

The environmental protection in rural tourist destinations is a complex and dynamic process that requires the active and extensive participation of various stakeholders, including the government, environmental organizations, and residents⁵. This study combines TPB with NAM theory, comprehensively considers the egoistic and altruistic attributes of residents in rural tourism areas, considers different dimensions of environmental policies as contextual factors, and explores the driving factors of PEB among rural tourism destination residents. The research findings provide empirical evidence for causal relationships in two theoretical frameworks, consistent with existing studies^{16,31,41,44}.

Analysis of egoistic psychological factors

The TPB theory believes that the occurrence of behavior is the result of a rational balance between individual expected benefits and costs, and has the attribute of self-interest. Especially, the analysis of the results indicates that the transition from PEI to PEB is predicted by multiple factors such as environmental attitudes and perceived behavioral control. Environmental attitude emerges as the most significant driving force behind PEI, thereby affecting PEB, indicating that local residents' perception and evaluation of the local ecological environment are the main factors affecting their willingness to participate in PEB. This result is consistent with the research findings of Shi et al.¹⁶ and Wang et al.¹⁷ on PEB among urban residents. Perceived behavioral control has a significant effect on PEI, which is consistent with the findings of Wang et al.³¹ and Zhang et al.³⁴. This indicates that local residents believe they possess the ability to perform PEB and have the necessary conditions to implement them. This further suggests that the local infrastructure and public awareness campaigns are well-developed³², thereby enhancing residents' sense of control over environmental behaviors and motivating their willingness to participate.

However, the subjective norms of rural tourist destination residents do not have a positive impact on their PEI, indicating that residents' PEB is not driven by pressure from those around them. It is worth noting that this is different from the research results on environmental behavior in the private sector²⁹, such as garbage classification¹⁸, low-carbon travel²⁷, and water reuse¹⁰. It indicates that under the influence of egoistic values, the pressure from external groups is insufficient to generate sufficient self-moral obligations among rural tourism destination residents, and government rewards and social honors have not yet played a motivating role. This situation may be related to specific research backgrounds. In rural areas, the social structure is relatively loose, neighborhood supervision is weak, and there is no strong social pressure. At the same time, traditional agricultural culture makes residents rely on nature and act according to their own habits and experiences, with low sensitivity to the views of others, making it difficult for subjective norms to play a role.

Analysis of altruistic psychological factors

The NAM theory emphasizes that moral obligations drive behavior. When individuals realize that their behaviors may lead to negative consequences and determine that they should be held responsible, internalized personal norms are activated, prompting them to implement altruistic behavior that goes beyond personal interests⁴³. In the causal chain of the proposed model, the results show that personal norms can activate PEI through two pathways: one is "consequence awareness \rightarrow personal norms", and the other is "consequence awareness \rightarrow responsibility attribution \rightarrow personal norms". It shows that personal norms can be directly activated through consciousnesses of results or indirectly activated through attribution of responsibility³⁰. Wang et al.³¹ found that the PEB of urban residents is mainly driven by altruistic attributes, which is also confirmed in this study when concerning about rural tourism destination residents. The stronger the identification, moral responsibility, and environmental awareness of rural tourism destination residents towards the local ecological environment, the more they can stimulate their PEB. After residents realize that the deterioration of the ecological environment will have adverse consequences, this awareness will awaken their awareness of environmental protection responsibility, thereby activating personal norms. When individuals choose to execute a certain behavioral intention, personal norms can prevent the occurrence of this behavior^{41,46}. The positive cognition and sense of responsibility of rural tourism destination residents towards environmental protection will activate their sense of moral obligation, which is consistent with the research of Tang et al.³⁷.

Analysis of environmental policy factors

The research findings indicate that the three categories of environmental policies, as significant contextual triggering factors, have various moderating effects on the association between PEI and PEB. This confirms that environmental policies play an important role in regulating intentions and behaviors^{34,57}. When the intensity of the three types of environmental policies perceived by residents of tourist destinations increases, it will greatly promote the implementation of their PEBs. Previous research focuses on explaining the PEB of residents through a single dimension of environmental policy^{36,37}. Consequently, it is difficult to assess the implementation effect of different types of environmental policies. Conversely, Therefore, based on the mature TPB-NAM theoretical framework, this study deeply explores the PEB of rural tourism destination residents under the influence of environmental policies from different dimensions, expands the research field and objects, provides a new perspective for understanding and promoting the PEB of rural tourism destination residents, and further enriches the relevant research on PEB. Among different types of policies, this study finds that the command-and-control policy have the most significant impact, as they establish norms and requirements for environmental behaviors and encourage residents to adopt PEB, which is effective in local environmental management. The effectiveness of economic incentive policies is slightly weaker compared to command-and-control policies. By offering economic subsidies or incentives, this policy motivates individuals to make positive choices concerning environmental behaviors effectively while alleviating their economic burdens. It is worth noting that, unlike previous studies that pointed out that economic incentives have no substantial impact on regulating urban residents' waste classification behavior³⁴, the results of this study indicate that command and control policies have the most significant impact, followed by economic incentives, while the impact of environmental policies involving public participation is relatively small. However, Zhang et al.³⁴ pointed out that public participation policies play a crucial role in increasing residents' awareness of environmental issues, and has long-term benefits in constraining residents' behavior.

Overall, the occurrence path of PEB among residents in rural tourism areas includes not only egoistic attributes that are beneficial to personal development, but also altruistic attributes that are beneficial to the entire society. Therefore, in order to promote the conscious implementation of PEB by rural tourism destination residents, it is necessary to gradually shift from "rational" to "moral" emotions. On this basis, combined with the regulatory role of environmental policies, the standardized development of PEB for residents in tourist destinations can be achieved.

Conclusions and recommendations

This study is based on TPB and NAM theory, combined with structural equation modeling, to explore the driving factors that affect the implementation of PEB by residents in rural tourism destinations from three perspectives: egoistic attributes, altruistic attributes, and contextual factors. Based on the analysis results, corresponding suggestions are proposed to promote the effective implementation of PEB among rural tourism destination residents.

- (1) Perceived behavioral control and environmental attitudes has a significant positive impact on the PEB willingness of rural tourism destination residents, which indirectly affects PEB. Subjective norms have no significant impact on the willingness of PEB. In response to this result, the local government should actively carry out rural tourism ecological environment protection publicity activities, guide rural tourism residents to establish a positive attitude towards environmental protection, and master necessary environmental protection skills^{5,34}. Under the leadership of village committees, community officials, or volunteers, regular public welfare lectures are organized to enhance residents' awareness that "green mountains and clear waters are invaluable assets". Secondly, by enhancing residents' awareness of facing and creating social "public opinion" pressure, and utilizing the guidance and demonstration role of neighbors, relatives, friends, and other residents, is beneficial to enhance their willingness to take PEBs²⁶.
- (2) Personal norms are activated through two pathways: "outcome consciousness → personal norms" and "outcome consciousness → responsibility attribution → personal norms", indirectly affecting their intentions to PEB. The altruistic attributes of local residents to implement PEB has been confirmed. Therefore, it is important to emphasize the role of local residents in protecting tourism resources, as well as the negative impact of not implementing PEBs, in order to activate the personal norms of residents³⁷. By organizing villagers and community residents to watch documentaries on ecological destruction, discussing the potential environmental problems it may cause, and raising residents' awareness of environmental concerns, it can stimulate their sense of pride in fulfilling environmental responsibilities and guilt for environmental damage, and enhance their moral responsibility to fulfill environmental responsibilities.
- (3) Environmental policies in various dimensions of contextual factors have a significant impact on the transition of PEI to PEB. Among them, command-and-control policies have the most significant impact, followed by economic and incentive policies and public participation policies. Therefore, it is necessary to fully leverage the role of environmental policies as important external triggers, and formulate and improve policy measures in various dimensions²⁶. Through various forms of activities such as broadcasting, announcements, and meetings, the disclosure of regional and practical environmental information on the current ecological environment and air quality of rural tourism destinations will be increased. At the same time, the investment and management of ecological environment construction should be increased⁵⁵. The government should establish strong policy support, actively attract social capital, effectively implement funds for rural ecological environment governance, and provide subsidies to encourage local residents to actively participate in environmental protection³³.

Theoretically, this study combines the TPB, NAM and the external situational factors - environmental policies, to develop a driving model for the PEB of rural tourism destination residents. The environmental behaviors of rural tourism destination residents driven by “egoism”, “altruism” and external situational factors are analyzed, breaking through the limitations of using traditional theories to explain environmental behavior. In practical terms, research results can not only stimulate the endogenous driving force of residents’ PEB, effectively alleviate environmental pressure in tourism development, but also promote the coordination and mutual promotion of ecological protection and economic development, providing an operable green development path for rural revitalization strategy.

However, this study also has some limitations: (1) the data used in this study comes from a survey of 316 residents in rural tourism destinations in Sichuan Province, which is cross-sectional data. Future research should adopt longitudinal tracking and causal reasoning methods to establish temporal relationships and strengthen causal claims derived from the research results; (2) This study mainly analyzes the occurrence path of PEB in rural tourism destinations from the perspective of residents’ psychological factors and external situational factors. Considering the background of rural areas, more comprehensive research can be carried out considering the impact of religious beliefs, local identity and other factors on the behavior of rural residents.

Data availability

Due to data protection and participant confidentiality concerns, datasets generated during and/or analyzed during the current study are available from the corresponding author upon request.

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Author contributions

X. H.: Conceptualization, Writing —review & editing, Funding acquisition, Supervision. X. Z.: Writing – Original draft, Methodology. Y. Z.: Writing – review & editing. R. M.: review & editing.

Declarations

Competing interests

The authors declare no competing interests.

Additional information

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